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著者	Miyake M, Tashiro M, Itoh M, Sugawara A, Kikuchi Y, Yamazaki K,, Ishii K
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IV. 5. The Use of Nuclear Medicine Systems for Veterinary Care and its Future Prospects

*Miyake M.², Tashiro M.², Itoh M.², Sugawara A.², Kikuchi Y.¹,
Yamazaki H.², and Ishii K.^{1,2}*

¹Graduate School of Engineering, Tohoku University

²Cyclotron and Radioisotope Center, Tohoku University

Nuclear medicine as a veterinary medicine in the United States

In the United States, the federal (Nuclear Regulatory Commission, NRC), state and local governments have been authorizing the medical use of radiation in veterinary care. In the 1980s, nuclear medicine was introduced to the field of veterinary care and was established as a specialized field in the 1990s. However, it seems that the use of radioisotopes for the veterinary care has been permitted as a part of “medical” use since there has been no provision specified for veterinary care. Thus, the permission seems to cover basically “human use” but also be applicable to domestic animals including pets and non-meat animals.

Currently in the United States, clinical investigations using radioisotopes have been commonly done for diagnosis of fractures among race horses. Fractures among race horses may affect not only the horses’ ability for racing but also their lives. In addition, the fracture shall make the horse-riders exposed to the risk of severe injury due to falling-off, so the prevention of fracture has been a very important issue in the clinical race-horse medicine. A radioactive tracer, the ^{99m}Tc-MDP, which has high affinity to the bone tissue, is used for the diagnosis of fracture in race horses. This tracer highly accumulates in a part of the bone tissue where bone-remodeling is activated, and can be used for diagnoses of “stress fracture” before resulting in complete fracture as well as “periostitis” that cannot be detected by X-ray.

Recent application of nuclear medicine for animals in Japan

In Japan, nuclear medicine examinations have been exclusively conducted for basic

research using experimental animals such as rats and mice, while few examinations have been done as clinical routines on pet animals. To date, there is no regulatory laws specifically applying to nuclear medicine examinations used in veterinary care, and the “Law Concerning Prevention of Radiation Hazards due to Radioisotopes, etc.” is directly applied. Therefore, animals treated with radioisotopes, in principle, should be sacrificed and kept in a radiation controlled area and finally should be disposed as nuclear wastes.

Current state of nuclear medicine examinations for veterinary care

Currently, X-ray photograph is taken very often in the field of veterinary medicine in Japan, but nuclear medicine examination is seldom done. An important reason for the current situation would be the fact that the legislation for conducting nuclear medicine examination is not ready yet, and the Law Concerning Prevention of Radiation Hazards due to Radioisotopes, etc. is limiting the use of radiopharmaceuticals to pet animals.

However, the current attitude of pet animal owners has been changing because of aging and variation of diseases among pet animals. The growing demand for advanced medical technology also for veterinary care has been encouraging the inclusion of nuclear medicine technique as a field of veterinary medicine. As already proven to be useful in the United States, the nuclear medicine is effective to prevent the injuries such as stress fractures among the race horses and therefore to reduce the risks of horse-riders’ falling-off in the race. The nuclear medicine such as PET and SPECT may be also useful for diagnosis in pet animals such as dogs and cats. SPECT imaging has already been applied to evaluation of the regional brain activity in dogs with anxiety disorder in Europe³⁾.

Future veterinary nuclear medicine

In order to meet the growing demand for improved veterinary care, a “working group on technical standards for radiation protection in veterinary nuclear medicine” was formed in the “Radiation Council” of the Ministry of Education, Culture, Sports, Science and Technology, Japan. This working group has discussed over an improvement of the legislation. For a moment, the following 3 types of the target contents and animals are under consideration,

- use of ^{99m}Tc bone scintigraphy to a horse,
- use of variety of ^{99m}Tc scintigraphy to a dog and cat, and
- use of ^{18}F -FDG PET to a dog and cat.

Regarding the practical legislation, new standards (laws) comparable to the Law Concerning Prevention of Radiation Hazards due to Radioisotopes, etc. and the “Medical Service Law”. Such a new standard is now considered for the radiation control of the facilities and the equipments radiation management of facilities and equipment for these tests.

Nuclear medicine equipments for animal in CYRIC

Currently at CYRIC, Tohoku University, there are three PET systems and a gamma camera system as nuclear medicine equipments for animals (Figs. 1 and 2). Table 1 shows the specification of these nuclear medicine systems at CYRIC. The ultra-high resolution semiconductors PET system (fine PET) is available for small animals such as rats and mice^{1,2)}. The PET systems, the PT-931-04 and the HEADTOME-IV are available for investigations of medium-sized animals. ZLC-7500 gamma camera is also available for medium-sized animals by using a parallel collimator and for small-sized animals by using a pinhole collimator.

Future prospects

We are going to continue basic experiments with radioisotopes as it has been. We hope the further advancement of basic research including drug development by using the ultra-high resolution semiconductors, PET-the-art system. In order to initiate clinical veterinary care at the CYRIC, we may have many things to do. We may need a renovation of the facility for veterinary care, recruitment of veterinary doctors and staffs to take care of radioisotope-treated animals. It is also important to examine the conditions regarding when and how the radioisotope-treated animals can be released from the controlled area.

References

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Table 1. Specification of nuclear medicine systems for animal in CYRIC.

	Ultra-high resolution semiconductors PET system	PT-931-04 PET system	HEADTOME-IV PET system	ZLC-7500 gamma camera
Crystal	CdTe	BGO	BGO	NaI(Tl)
Num of crystals	5120	2048	3072	1
Num of slices	16	7	7	N.A.
Field of view	6.4 cm (diameter) x 2.4 cm (axial)	65 cm (diameter) x 4.7 cm (axial)	51.2 cm (diameter) x 8.8 cm (axial)	387 mm (crystal diameter) x 9.5 mm (crystal thickness)
Spatial resolution	under 1 mm	5.0 mm ~ (diameter) x 6.7 mm ~ (axial)	4.5 mm ~ (diameter) x 11.0 mm (axial)	3.9 mm (intrinsic)
etc				energy resolution : 10.1 % (^{99m}Te) nuclide : ^{99m}Te , ^{201}Tl , ^{123}I , ^{131}I , ^{67}Ga , ^{111}In etc collimator : high resolution parallel, middle energy parallel, pinhole etc



Figure 1. Nuclear medicine systems for animals. Left figure shows PET systems. From the left, ultra-high resolution semiconductors PET system, PT-931-04 PET system, HEADTOME-IV PET system. Right figure shows ZLC-7500 gamma camera.

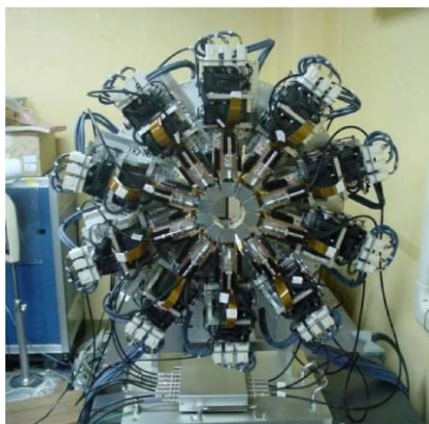


Figure 2. Ultra-high resolution semiconductors PET system.